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AN EMPIRICAL EVALUATION OF STUDY HABITS FOR COLLEGE COURSES IN FRENCH AND SPANISH*

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INTRODUCTION

This is the third in a series of studies[4,7] wherein the authors have sought to investigate the relationship between performance in college language courses and procedures employed in study.

We have chosen to study the effectiveness of particular study procedures in the language area for several reasons. There are numerous suggestions[2,3,5] which are widely used by students, teachers, and counselors, but most of these suggestions have not been subjected to empirical test. The methods of study used in learning are probably of greater importance in successful achievement in languages than in most other courses.[2] Moreover, it may reasonably be assumed that, due to the well-defined nature of the content of language courses, final grades in such courses would tend to be among the most reliable found in the liberal arts curriculum. Furthermore, our inquiries have led us to believe that relative to most non-mathematical and non-

* The writers wish to acknowledge their gratitude for the assistance of the staffs of the French and Spanish Departments of the University of Illinois.

scientific studies, the requirements of an elementary language course of a given type are well-defined and quite general from class to class, teacher to teacher, and school to school.

In response to war needs, a variety of experimental programs in language instruction have been developed and applied. Prior to that time the Reading methods, the Direct or Reform method and the somewhat formal Grammar-Translation method have been in general use. The Direct method attempts to teach the student to read, write, and speak the language without translating into the vernacular. The Indirect or Grammar-Translation method advocates intensive study of vocabulary and grammar with little emphasis on reading and translating into the vernacular. The Coleman report[1] and other studies indicate that the prevalent tendency in modern language teaching involves an eclectic approach which draws heavily upon the most desirable features of the Direct method and the Indirect method. The instruction in the first year course of Spanish and in the first year course of French at the University of Illinois may be considered as representative of the instructional pattern which is most prevalent in the elementary study of language at the senior high school and college levels. The second year courses in both French and Spanish as taught at the University of Illinois provide an increased use of the reading approach. The writers feel that the differentiation between these two levels of instruction is quite general and reasonably representative of the pattern commonly encountered. Many schools, however, diverge sharply from these practices and the relevance of our findings to their instructional procedures can best be judged by those responsible for instruction.

Although it was hoped that these studies would result in general observations relevant to learning methods, pedagogy, and student attitudes, more specifically the purpose of the authors was to determine, empirically, the academic advantages or disadvantages which accrue from specific student practices, shortcomings and attitudes. The approach has been indirect; various indices of academic performance have been correlated with student reports on study practices. In earlier studies[4,7] both interviews and inventory data have been employed; it has never appeared feasible to make a direct study of actual student behavior.

These studies have particular value for people employed in student guidance. A knowledge of effective, empirically evaluated study procedures is valuable in advising inefficient students. It is likely, moreover, that such knowledge should have a value to those directly responsible for instructional work in languages as well as the persons doing general education guidance. It has also been found in the experience of the writers that many students who do not desire extensive counseling are eager to have a knowledge of the relative advantage and disadvantage of various study procedures. Such material, when it is available, can be distributed by teachers or advisors directly to the students for their independent use. The results of the investigations have also been used by the writers in diagnostic study habit questionnaires. The counselor frequently finds these useful in directing the student; the teachers can take advantage of them in their instructional emphasis; and often the knowledge of the student's performance on such a questionnaire is directly stimulating to him.

THE QUESTIONNAIRE

In the present study an attempt has been made to evaluate the items of a study habit questionnaire. This questionnaire was prepared in two forms: 1) for students of French, 2) for students of Spanish. The form prepared for the French students comprised ninety items, whereas that prepared for the Spanish students included one hundred and one items. Eighty-five items were common to the two questionnaires. The respective forms of the questionnaire were administered to groups of students who were completing one of the first four semesters of college French or Spanish.

The students were freshmen and sophomore men and women enrolled in the Liberal Arts and Science College at the University of Illinois. None had had experiences with any romance language prior to their enrollment at the University. The data were collected during the academic years 1940–41 and 1941–42. No student was a member of more than one group and every effort was made to eliminate students who were repeating a language course. The questionnaires were administered during the next to the last week of the respective semesters.

The items of the questionnaire were designed to yield informa-

tion about specific practices, attitudes or difficulties. They are answerable in a mutually exclusive 'yes' or 'no' manner. The complete list of items is given in the Inventory. The first eighty-five items were common to both the French and Spanish forms. The succeeding five items were included on the French form only and the final seventeen items appeared on the Spanish form only.

INVENTORY

Directions: This is an inventory of your study habits. You are asked to answer the following statements not according to how you think you should study or what you ought to know, but according to how you actually do study and what you actually do know.

Please place an (X) in the parenthesis in front of each statement to which you would answer 'yes,' and a (−) in front of each to which you would answer 'no.' These statements refer only to the study of French (Spanish). Make an answer to each statement.

Items Common to Both the French and Spanish Forms

( ) 1. I study French (Spanish) at a time of day when I work efficiently.
( ) 2. I find it hard to keep my mind on what I am studying.
( ) 3. I try to master each lesson or assignment.
( ) 4. When writing examination, I get so nervous that I cannot do my best.
( ) 5. I often get tense and nervous when I study.
( ) 6. I understand what the instructor wants to achieve by having the students do certain things in class.
( ) 7. I practice and drill all new material in order to make it as nearly automatic and habitual as possible.
( ) 8. Talking, noises, etc., severely handicap me while I am studying.
( ) 9. I think of grammar as an end in itself not as a means to an end.
( ) 10. I prepare my assignments by going through them only once.
( ) 11. I usually get through my French (Spanish) assignment in the time I have set aside for studying it.

( ) 12. I am not able to apply correctly in written work those grammar rules which I know.
( ) 13. I follow a study schedule which allows me ample time for French (Spanish) preparation.
( ) 14. I study conjugations by applying them in exercises in the textbook.
( ) 15. When I run into a difficult sentence or clause in new reading material, I first look for the subject, verb, and object and then try to group the remaining words about them.
( ) 16. When I read a reading text for the second or third time, I begin to read ideas rather than single words.
( ) 17. I read and re-read in French (Spanish) each reading passage until I am able to follow its idea or content.
( ) 18. I study corrections on written work until I understand the cause of the errors and can correct them myself.
( ) 19. The position of pronouns in affirmative imperatives and negative imperatives does not offer me any trouble.
( ) 20. I frequently fail to recognize regular verb tense endings.
( ) 21. In translating from English to French (Spanish) I make errors because I cannot apply rules governing the position of pronouns.
( ) 22. I am able to recognize irregular verbs occurring in various tenses when reading from French (Spanish) to English.
( ) 23. I often hesitate to recite because I am uncertain of pronunciation.
( ) 24. I always learn the definite article with the noun.
( ) 25. I drill particularly on irregular verbs.
( ) 26. In writing examinations and exercises, I make few errors in the position of adjectives and nouns.
( ) 27. I never drill pronunciation outside of class.
( ) 28. I have difficulty with word order in interrogative or interrogative negative construction.
( ) 29. I sometimes learn difficult idioms by analyzing them with a literal translation.
( ) 30. In reviewing verbs I organize them with reference to tenses, moods, and irregular forms, with examples of each.

( ) 31. In reviewing pronouns I organize them as being subject and object pronouns, as well as relative, interrogative pronouns, and disjunctive pronouns.
( ) 32. I make a list of all important idioms.
( ) 33. I have difficulty in using relative and interrogative pronouns.
( ) 34. My study periods for French (Spanish) are often too short for me to get 'warmed up' to the task of study.
( ) 35. I often find myself too tired, sleepy or bored to study French (Spanish) efficiently.
( ) 36. I memorize all idioms.
( ) 37. I have a tendency to daydream while trying to study French (Spanish).
( ) 38. I have difficulty in knowing when to use an adjective and when to use a pronoun.
( ) 39. If I miss a class, I see my instructor about making it up.
( ) 40. I attend or participate in some activities sponsored by the French (Spanish) Club, for example, movies, plays, lectures, etc.
( ) 41. I often fail to recognize idioms when translating.
( ) 42. I always examine a sentence for its meaning before translating it.
( ) 43. I make an effort to pronounce each vowel and consonant correctly, attempting to assume the proper position of the vocal organs.
( ) 44. I learn thoroughly all words which connect or introduce clauses and phrases.
( ) 45. I listen carefully to the pronunciation of French (Spanish) by the teacher and students.
( ) 46. There are some words I have to look up many times.
( ) 47. I learn to see phrases and clauses as units related to other sentence units.
( ) 48. I know the common prefixes and suffixes.
( ) 49. I have difficulty in distinguishing between French (Spanish) sounds.
( ) 50. If a foreign word is difficult to remember, I write it on one side of a slip of paper with its English meaning on the reverse side, studying each until I remember the other.

( ) 51. I can analyze an English sentence, telling the parts of speech and their function.
( ) 52. I do not understand some of the terms used in the study of a language.
( ) 53. I try to get clearly in mind the purpose of each lesson before I attempt to master it.
( ) 54. I have no trouble in recognizing parts of speech in French (Spanish).
( ) 55. I make a serious effort to master the pronunciation of individual letters as soon as possible.
( ) 56. I do a certain amount of reading in an easy supplementary text.
( ) 57. I am alert to the recitations of other students.
( ) 58. I practice that which is most difficult.
( ) 59. I am always active in concert pronunciation in class.
( ) 60. I write between the lines of the French (Spanish) text the meaning of words or phrases that seem difficult to remember.
( ) 61. I read the whole lesson through before looking up any words.
( ) 62. I feel that French (Spanish) is particularly difficult for me.
( ) 63. I learn thoroughly all conjunctions and prepositions.
( ) 64. I study with others rather than by myself.
( ) 65. I learn as many French (Spanish) words as possible using as a cue the similarity of their English equivalents.
( ) 66. I note the grade written on an examination paper but postpone and eventually forget to correct the mistakes made during the test.
( ) 67. I prepare my French (Spanish) assignments regularly instead of spasmodically.
( ) 68. I generally check the meaning of unfamiliar words or idioms before concluding the study period.
( ) 69. I am concerned about improving my study methods in French (Spanish) so that I can do more and better work in the same amount of time.
( ) 70. I gladly accept a hard French (Spanish) assignment as a challenge to my ability instead of giving up at the first sign of difficulty ahead.

( ) 71. It is particularly difficult for me to translate from English to French (Spanish).
( ) 72. I anticipate questions the teacher may ask and prepare myself to answer them.
( ) 73. I practice grammar by working with examples rather than learning the rules.
( ) 74. I learn some unfamiliar compound words because I am acquainted with their roots, suffixes, and prefixes.
( ) 75. I try to associate French (Spanish) words or phrases directly with the concrete object, idea, or feeling which they represent and not simply with the English word.
( ) 76. When I find a new grammar term, I am careful to get a clear idea of what it means immediately.
( ) 77. I alternate different types of work to avoid boredom and fatigue.
( ) 78. I write original sentences to practice the grammar points I am studying.
( ) 79. The radio is generally on when I study French (Spanish).
( ) 80. I keep all my written work so that I can study past errors.
( ) 81. I ask my teacher to explain difficulties I have encountered in my study.
( ) 82. I have difficulty in distinguishing which comes first, the direct or the indirect object pronouns.
( ) 83. I don't know how to check my French (Spanish) to English translation.
( ) 84. Whenever a new word is pronounced by the teacher, I try to visualize how it might be spelled, thus learning to associate sound with spelling.
( ) 85. The position of the pronoun in compound tenses is difficult for me to determine.

Items Found in the French Form Only

( ) 86. When I first meet a new irregular verb, I learn its principal parts.
( ) 87. Sometimes I confuse the adverbial ending *ment* with a tense ending of a verb.
( ) 88. I have difficulty in distinguishing between a partitive and an ordinary *de* phrase.

( ) 89. I learned the phonetic symbols when they were assigned.
( ) 90. I err in distinguishing between *mieux* and *meilleur*.

Items Found in the Spanish Form Only

( ) 91. I confuse the reflexive *se* and the indirect object *se*.
( ) 92. I practice grammar both by learning rules and by working with examples.
( ) 93. I memorize verbs and vocabulary in short and numerous study sessions rather than in a few long periods.
( ) 94. I always learn the definite article with the noun, when the latter does not end in *o* or *a*.
( ) 95. I learn the vocabulary assignment each day.
( ) 96. I cross-classify all personal pronouns by (1) type, i.e. direct object, indirect object, reflexive, etc. and by (2) person, i.e. *el se, le, lo(le)*, etc.
( ) 97. I make a short and brief outline or summary of each division of grammar which has been presented piecemeal in the text.
( ) 98. I understand the main uses of the reflexive, that is, I do not learn this subject merely by memorization of the forms.
( ) 99. In translation from English to Spanish, before attempting to write the Spanish sentence, I re-word the English so that it is as nearly like the Spanish as possible.
( ) 100. In learning vocabulary I analyze a new word, noticing known roots, prefixes or suffixes.
( ) 101. I am not confused by the use of adjectives for nouns and pronouns in Spanish.
( ) 102. I find it difficult to distinguish between the use of the infinitive and present participle in Spanish.
( ) 103. I have studied another foreign language for more than a year.
( ) 104. I find the uses of the article in Spanish confusing.
( ) 105. I learn vocabulary by arranging new words in related groups wherever possible, i.e., relatives, parts of the body, days, months, etc.
( ) 106. I learn vocabulary in part by associating the Spanish word with a similar word in another foreign language I know.

( ) 107. I have trouble distinguishing between *mas grande* and *mayor.*

THE DATA, FRENCH QUESTIONNAIRE

The data for the two forms of the questionnaire will be analyzed separately. The records of five hundred fifty-five students to whom the French form was administered were eligible for inclusion in the study. The distribution of the students by course and by grade earned is given in Table I.

TABLE I.—DISTRIBUTION OF STUDENTS BY COURSE AND BY GRADE EARNED

Semester	Course	Grade Earned					Total
		A	B	C	D	E*	
First, Freshmen.....	1a	30	34	47	20	10	141
Second, Freshmen.....	1b	29	33	59	17	5	143
Third, Sophomores....	2a	23	27	43	22	11	126
Fourth, Sophomores...	2b	30	37	50	24	4	145
Total.....	..	112	131	199	83	30	555

* E as a grade indicates failure in the course.

Elementary French 1a is a course in grammar, pronunciation, reading of modern authors, composition, conversation, etc. French 1b is a continuation of French 1a. Modern French 2a is a course in rapid reading of modern authors, syntax and composition. French 2b is a continuation of French 2a.[6]

The items of the questionnaire were evaluated on the basis of marks earned in the respective courses. This was done, course by course, by finding for each item the per cent of A, B, C, D, and E students who responded 'yes.' When the data are in this form, a test for freedom of dependence or correlation between response on questionnaire item and grade earned may be made conveniently. In evaluating an item it is not sufficient, however, to reject a hypothesis of independence. For any reasonable use to be made of a significant relationship in these data, it is necessary that it be of a continuous nature free of significant

inversion. To perform the indicated statistical tests for each item as used in the various courses for both the French and the Spanish questionnaire would involve a prohibitive amount of computational labor. As a consequence, a statistically inelegant but practical procedure has been employed.

The nature of the needs and interests which prompted this study resulted in our seeking to identify items which have a consistent and predictable relation with course grades. It was arbitrarily decided that a relationship would be recognized as 'significant' if the difference in the per cent of A students responding 'yes' to an item and the per cent of D students responding 'yes' was at least fifteen (it is fully realized that the significance of the difference between two proportions is not due solely to the size of the differences). It was further decided that a 'significant' relationship would be considered sufficiently consistent if no inversion of more than two per cent occurred. In the analysis, little cognizance was given to the extremely small failing groups with the grade of E.

Of the ninety items comprising the French form of the questionnaire, fifty-five either appeared to be without value or had predictive value for only one course. The particularly discriminating items were chosen for further scrutiny. The basis for this selection was two-fold: 1) when all the data for the four classes were combined, responses to an item must show a consistent relation with grades; 2) in addition, responses to the item must show a consistent relationship with grades earned in at least two of the four semesters.

Table II is a digest of the findings for the thirty most discriminating items. Column I gives the number of the item of the questionnaire. In column II is entered the per cent of persons saying 'yes' to items which showed a consistent relation with grades earned in the first semester of college French. In columns III, IV, V are entered comparable data for the second, third, and fourth semesters, respectively, of college French. In column VI is given the per cent of persons of the combined classes who responded 'yes' to each item. In column VII is given item by item the per cent of students earning the grade of A who responded 'yes.' In columns VIII, IV, X, and XI is given item by item the per cent of persons responding 'yes' who made grades of B, C, D, and E, respectively. The table

TABLE II.— PER CENT OF STUDENTS IN EACH FRENCH COURSE* AND IN EACH GRADE CLASSIFICATION WHO MARKED ITEM (X), (YES)

	Courses					Grade Classifications				
Item	1a	1b	2a	2b	Total	A	B	C	D	E
I	II	III	IV	V	VI	VII	VIII	IX	X	XI
N =	141	143	126	145	555	112	131	199	85	30
2.	.34	.37		.33	.36	.29	.31	.37	.47	.50
4.	.46		.37	.30	.37	.22	.24	.43	.51	.63
11.	.52	.55	.46	.63	.53	.71	.65	.49	.24	.27
12.	.36	.41		.40	.39	.10	.30	.46	.59	.80
15.		.50		.68	.56	.70	.53	.55	.45	.43
18.		.56		.77	.67	.78	.63	.59	.49	.40
19.	.43			.67	.54	.71	.62	.47	.47	.07
21.		.31		.30	.33	.23	.26	.37	.36	.63
22.				.71	.64	.77	.65	.63	.55	.33
23.	.57	.61	.47		.53	.42	.48	.54	.71	.63
26.	.55	.66		.71	.60	.73	.66	.58	.47	.23
28.				.29	.39	.26	.27	.43	.57	.57
32.	.38	.41	.52	.63	.47	.33	.44	.50	.63	.50
35.		.51	.51		.53	.29	.56	.59	.66	.50
37.	.28		.35	.28	.32	.14	.28	.38	.40	.53
38.	.21				.16	.10	.09	.18	.24	.27
47.			.67	.80	.67	.80	.74	.58	.58	.67
52.	.48	.39	.34	.37	.39	.15	.34	.46	.53	.63
54.			.52	.67	.52	.70	.57	.48	.34	.37
62.	.33	.35	.38	.40	.35	.07	.18	.43	.69	.80
67.	.77	.68	.78		.53	.86	.79	.70	.64	.50
70.	.72	.62	.66	.79	.68	.78	.74	.65	.59	.50
71.	.45	.51	.52	.53	.49	.22	.37	.58	.72	.67
74.		.57		.74	.61	.67	.65	.65	.43	.43
76.	.62	.57			.61	.80	.63	.57	.51	.37
82.		.37		.31	.35	.24	.27	.40	.42	.67
83.	.39				.37	.28	.34	.36	.49	.53
85.	.50	.45		.34	.40	.21	.35	.46	.48	.73
87.	.26	.30	.18	.18	.23	.09	.12	.27	.41	.40
88.	.52	.43	.48	.45	.46	.23	.38	.52	.61	.77

* Per cents are omitted for all courses in which the item failed to show a 'significant' relation to grades.

is based upon the combined group of five hundred fifty-five students.

DISCUSSION

In an attempt to analyze and evaluate further the thirty most discriminating items of the French form of the questionnaire, they were examined for similarities. After some scrutiny and reclassification of the items, it was found possible to place them into three categories. The three classifications were: I) items which seem to be related with the student's efficiency as possibly determined by general adjustment or emotional factors; II) items which seem to be characterized by a factor of knowledge or specific information; and III) items which call for a skill component in study efficiency. The items were subsummed under these headings with no overlap. The following outline gives the principal classifications, the various subclassifications, and the number of the particular items assigned to each of the groups:

Type of Items	Items	Total
I. Personal or Emotional		
A) Concentration	2, 35, 37	3
B) Anxiety	4	1
C) Confidence	62, 70	2
		6
II. Knowledge of Subject-matter or Content		
A) Pronouns	19, 21, 38 (82, 85)	3
B) Endings and verbs	22, 87	2
C) Pronunciation	23	1
D) Prepositions	88	1
E) Word order	26, 28, 82 85	4
F) General	12, 52, 54, 71	4
		15
III. Skill and Study Technique		
A) Time	11, 67	2
B) General, insight	15, 18 47, 74, 83	5
C) Rote method	32, 76	2
		9

It is significant that fifty per cent of the thirty relevant study habit items have to do with the student's knowledge or mastery of the subject-matter. Within this category it is quite interesting to find that the most troublesome specific area is that of word order; the second most troublesome one is the use of pronouns. Items 82 and 85 have been arbitrarily classified pertaining principally to word order; but they could be classified as pertaining primarily to the use of pronouns. Most conspicuously and perhaps surprisingly absent are the vocabulary and idiomatic classifications. It seems that the subject-matter weakness which is most related with student's achievement has to do with grammar and is not particularly dependent upon the mastery of idioms and problems of vocabulary.

The implications of the summary given in this outline are relevant for the instructor and the counselor. It is apparent that emotional factors in the student's adjustment are important in determining the quality of his work. Such problems as these are commonly the problems of the counselor. It is equally apparent that certain specific skills and techniques of study also determine the student's standing. Instruction in effective methods of work is the responsibility of the teacher and the counselor as well. However, the items which have to do with the student's mastery of subject-matter place the responsibility upon the counselor, teacher and student.

The diagnostic questionnaire can serve to direct the student's attention to the areas in which he is weakest and to indicate to the teacher the specific area in which the student feels insecure and is failing to make achievement. It seems reasonable to propose that the use of a diagnostic study habit questionnaire could be a useful supplement to classroom procedure. Ordinarily a teacher depends upon his classroom observations and examinations to inform him of the student's strengths and weaknesses. In many classes, however, it is not possible to work sufficiently closely with the student to determine exactly what his weaknesses are. Often the student's performance on the examination may be invalid because it cannot sample a wide enough portion of his skills. It does not indicate how confident a student is of his work, or whether a student is able to pass an examination because of some herculean effort or some 'lucky fluke.'

French 1a and 1b are the most elementary courses and are offered during the freshman year. They place particular emphasis upon grammar. Courses 2a and 2b are sophomore courses and place a greater emphasis upon reading and composition. It is to be expected that some of the items have greater predictive power for one level of study than for another. In order to determine the relative value of items for the two levels of instruction, the data for the freshman courses were pooled and the data for the sophomore courses were combined in another pool. From an examination of these pooled data, it was found that certain items were uniquely significant to the freshman French courses and certain other items were uniquely significant to the second year study of French. The seven items which had predictive value for the freshman year but not for the sophomore year were 15, 21, 35, 38, 67, 83 and 85. Three of these items, 15, 67 and 83, were concerned chiefly with the student's approach to his work. Item 35, which had to do with concentration, falls under the general heading of those items which have to do with a student's attitude toward his work or his general adjustment. Three of the items, 21, 38 and 85, had to do with content difficulties.

Four items were found to be uniquely significant to the second-year course. These were 19, 22, 82 and 47. All except item 47 were concerned with various content features of the course, the amount of knowledge or proficiency that the individual possesses. Item 47 had to do with the student's approach in his studies and may be classified as a skill item. These data suggest that the significance of the approach aspect, that is the how-to-study aspect of the student's difficulties, was more marked during the freshman year and less important during the second year. This seems to be a reasonable inference because those students doing second-year French had more opportunity to learn how to approach the work efficiently and how to adjust their attitudes to the work. It is also likely that there has been some selective factor—the weaker students and those who found the language study less compatible have dropped out and not undertaken the second year of French. In addition to the probable effect of sampling on these differences, it is likely that the differences reflect the demands of the freshman and the

sophomore courses. The second-year work is less formal, the learning is less stereotyped than for the first-year course.

The preceding discussion is based upon the thirty most generally significant items selected for further scrutiny. The tendency for study skill and techniques to be more important during the first year than during the second year of study becomes more apparent when we analyze the pooled data for all ninety of the items on the French form of the questionnaire. In Table VI the items found significant for the first-year course in French are classified; the items found significant for the second year of study are mentioned in the text.

Despite the apparent tendency for skills and study techniques to be of relative greater importance for the freshman course, we cannot state with a high degree of confidence that the responses of the freshman group are drawn from a different population from the responses of the sophomore group, i.e., we cannot say at a high level of confidence that the two courses differ in the way in which the items may be classified.

It was also observed on examination of the pooled data for the thirty selected items that changes in the frequency with which certain practices, attitudes, or needs were reported vary from the freshman to the sophomore year. There were thirteen items wherein the difference between the first and second year in the number saying 'yes' was fifteen per cent or more. These items were numbers 2, 12, 35, 47, 52, 54, 62, 67, 71, 74, 76, 85 and 87. The changes in frequency of the 'yes' response was quite varied from item to item and the actual differences ranged from minus forty-two to plus twenty-eight per cent. All of these differences were in the desirable direction with the exception of differences for items 67 and 71. By differences being in the desirable direction is meant that the number saying 'yes' to a presumably undesirable item decreased from the freshman to the sophomore year and the number saying 'yes' to an apparently desirable item increased. The data for item 67 suggest that the sophomores may be less methodical than the freshmen. The apparently undesirable change with respect to item 71 may merely reflect the differences in the content of the courses at the two levels. During the sophomore year the emphasis is on reading French. Since almost all the changes are in a so-called desirable direction, one might raise the question of some selec-

tive factor being at work, such as the elimination of students who as freshmen report undesirable practices. Due to the variability of the differences, it is probable that this is not the chief cause. Thirteen of the items fall into the three classifications in much the same proportion as the original group of thirty did. Three of them fall in group I, seven in group II and three in group III. In other words, with respect to the prevalence with which responses in each group occur, there seems to be no marked difference between the pattern of the freshman year and the pattern of the sophomore year.

Out of the total list of significant items, one—no. 32—seems to be inversely related with grades, that is, the presumably desirable practice described by item 32 is actually less characteristic of the good students and more characteristic of the poor students. In a later section where an attempt is made to control for intelligence, it will be found that the practice described by this particular item is most characteristic of the less intelligent student.

In this particular study it is possible to control the amount of experience the students have had with language and the amount of college training that they have had in general. It is not feasible, however, to control the nature and the complexity of the curricula of the students, the degree of motivation that a student may have, the stimulation of his home, the number of extracurricula activities he carries, or the number of hours he spends in employment. It is conceivable that these uncontrolled factors affect our data in some way or another.

Another factor which has not been controlled in the tabulations just analyzed is the factor of intelligence or general scholastic aptitude. Although it is essential to know the degree to which desirable or undesirable scholastic effects are associated with certain study needs, practices, or attitudes, it is desirable but not necessary to know that a particular study practice alone is effective in determining the relationship between that practice and grades. The predictive value and the general use of the study habit items is not contingent upon that knowledge. The counselor or teacher who works individually with the student and makes diagnoses of study difficulties is cognizant of the general effect of such uncontrolled factors as: level of ability, motivational factors, amount of time worked, etc.

TABLE III.—CORRELATION OF EACH OF THE THIRTY SELECTED ITEMS WITH—

Item	Final Examination in French 1b	Psychological Examination	Final Examination Minus Psychological Examination
2	−.46	.04	−.56*
4	−.20	−.17	−.14
11	.35	.36	.21*
12	−.46	−.39	−.34*
15	.25	−.06	.33
18	.30	.21	.24*
19	.14	.35	−.04
21	−.22	−.49	.03
22	.15	.01	.18
23	−.29	−.01	−.34
26	.19	.63	.16*
28	.31	−.49	.39
32	−.10	−.86	.75
35	−.12	.26	−30
37	−.10	.44	.16
38	−.22	−.51	.40
47	.14	.04	.14
52	.07	−.40	.35
54	.28	.07	.29
62	−.48	−.24	−.43
67	.19	−.07	.26
70	.22	.29	.10
71	−.40	−.64	−.10*
74	.14	−.10	.22
76	.22	−.16	.36
82	−.59	.10	−.75*
83	−.27	.15	−.40
85	−.53	−.08	−.58*
87	−.51	−.12	−.53*
88	−.33	−.26	−.24*

* Items related with grades earned in the course and also significantly correlated with the final examination score.

TABLE III.—*Continued*

Items with Biserial Correlations of ± 30, or More Which Are Not among the Thirty Significant Items Given in Table II

Item	Final Examination in French 1b	Psychological Examination	Final Examination Minus Psychological Examination
6	.35	.03	.34
31	.31	−.04	.39
52	.36	.06	.39
66	−.64	−.72	−.07
86	.30	−.29	.54

The effect of intelligence or scholastic aptitude, however, is very general, and it is of value to know to what degree it participates in the relationships we have observed. For example, item 32, which to all appearances is a desirable study procedure, is actually more characteristic of the poorer students than of the good students. The prevalence with which this item is practiced, moreover, is slightly greater during the second year than during the first. It may be that the practice of this item is simply characteristic of the less intelligent students and for that reason cannot justifiably be branded as an undesirable study technique. Although item 32 is the only one which shows this curious type of relation, an effort has been made to control the effect of intelligence. It was not feasible to give all the students who have participated in this study a test of intelligence. It was found, however, that a number of students had participated in the program of the popular student guidance service of the Personnel Bureau of the University of Illinois and in process had been given a test of scholastic aptitude. The test given to these students was the American Council of Education Psychological Examination and it was found that in one of the groups, the students of French 1b, eighty-one had taken this test of scholastic aptitude during their freshman year. This admittedly is not an unbiased sample, but an analysis of it may be of some interest. A correlational analysis proceeded as follows for these eighty-one students: the correlation between response to each item and scholastic aptitude score was determined, the correlation between

each item and the lengthy objective final examination of the course was determined, and the correlation between the final examination and scholastic aptitude test was found to be .50.

Table III gives biserial correlations between response on each of the thirty selected items and total score earned on the American Council Psychological Examination, response on item and score earned on the objective final examination in French 1b and finally the correlation between the response on the item and the final examination score when the effect of intelligence has been partialled out by use of the appropriate statistical formula.

It is found that several items which were highly related with grades in French 1b do not show a significant correlation* with the final examinations. Moreover, it is found that several items were significantly correlated with the final examination grade but were not among those items which appeared to be highly related with the grade earned in the course. Such discrepancies as these can be accounted for in terms of the difference between the two criteria, i.e., final grades and final examination scores. It is also possible that some of this discrepancy is due to a sampling factor. All persons whose records were employed in the tabulation of French 1b in Table I did not participate in the intelligence testing upon which Table III is based.

Those items which were regarded as importantly related with grades earned in the course and were also significantly correlated with the final examination score were investigated further. They are marked by an asterisk on Table III. Two of these items, 26 and 71, show particularly large correlations with the Psychological Examination and as a consequence when intelligence is held constant their predictive significance is lost. With respect to item 26, it appears that students who make few errors in positions of adjectives and nouns tend to be superior on the Psychological Examination scores whereas the performance of those students who find it difficult to translate from English to French (item 71) tend to be inferior on this test. The highest correlation between any item and the results of the Psychological Examination is minus .86. This is item 32, which was found in the earlier analysis to have a paradoxical relation with grades.

* The standard error of a biserial correlation coefficient is determined by the point of dichotomy as well as the size of the sample. In this study a correlation of .30 is arbitrarily accepted as 'significant.'

It had been found when the analysis was made on the basis of grades that the tendency to list important idioms was strikingly characteristic of the inferior student. The correlational analysis indicates that this tendency is due to the fact that the habit is most characteristic of the less intelligent student. Although the results of such correlations are frequently difficult to interpret, they imply that this particular habit is not deleterious. Fourteen of the significant items listed in Table III show partial correlations as great as .3.* When these items are classified according to the outline we have used, three are found to fall in the adjustment or attitude class (I), seven in the content class (II), and four in the method or skill class (III). This distribution of the items with respect to the three classes is quite comparable with that found in the original classification. We may infer, thereby, that although approximately fifty per cent of our significant study habit items describe difficulties with specific phases of subject-matter, these difficulties cannot be accounted for on the basis of intelligence as measured by the Psychological Examination. Whether these important difficulties are due to methods of study and approach cannot be determined from our data. Such questions as those may be answered by a study of the inter-correlations of study methods.

THE DATA, SPANISH QUESTIONNAIRE

The records of seven hundred twenty-eight students to whom the Spanish form of the questionnaire was administered were eligible for inclusion in the study. The distribution of the students, course by course and grade by grade, is given in Table IV.

Elementary Spanish 1a is a course in grammar, pronunciation, reading, composition, and conversation. Spanish 1b is a continuation of Spanish 1a. Modern Spanish 2a is a course in rapid reading, review of grammar, composition, and conversation. Spanish 2b is a continuation of Spanish 2a.[6]

Since the amount of data collected for the students in the sophomore courses was somewhat limited, only the analysis of the pooled data for the freshman courses of Spanish 1a and 1b

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* This value is arbitrarily taken as 'significant' in the present study.

will be made. The items meeting the two-fold criteria given under the section on 'The Data, French Questionnaire,' are shown in Table V. In this table the first column gives the number of the item in the questionnaire; in the second column are given, item by item, the per cent of students earning the grade of A who responded 'yes'; in the third, fourth, fifth, and sixth columns are given, item by item, the per cents of students saying 'yes' who made grades of B, C, D, and E, respectively. In column VII is given the per cent of the Freshman group of students who said 'yes' to each item.

TABLE IV.—DISTRIBUTION OF STUDENTS, COURSE BY COURSE, AND GRADE BY GRADE

Semester	Course	Grade Earned					Total
		A	B	C	D	E	
First Freshmen.....	1a	75	87	123	49	38	372
Second, Freshmen.....	1b	31	47	93	39	22	232
Third, Sophomores....	2a	15	18	48	18	5	104
Fourth, Sophomores...	2b	3	6	11	0	0	20
Total.....	..	124	158	275	106	65	728

One important question which this study may answer is whether study habits which are effective in one language are equally effective in learning another language. Of the eighty-five items which were common to the two forms of the questionnaire, certain ones are equally significant for success in the study of both French and Spanish while other items are significant for success in French only or Spanish only. Some of these significant items are unique to the French form of the questionnaire while others are unique to the Spanish form. The items comprising each of these groups have been outlined according to their nature and the results are summarized in Table VI.

The question as to whether study habits which are effective in one language are equally effective in learning another language will be answered in terms of class of study habit items. If from

TABLE V.—PER CENT OF STUDENTS IN EACH GRADE CLASSIFICATION AND ALSO STUDENTS IN SPANISH 1A 2B WHO MARKED ITEM (X), (YES)

Item	A	B	C	D	E	1a + 1b
I	II	III	IV	V	VI	VII
N =	106	134	216	88	80	604
2	.14	.34	.46	.47	.53	.39
3	.86	.72	.69	.67	.57	.71
11	.82	.64	.52	.40	.27	.55
12	.12	.34	.51	.57	.70	.43
15	.72	.67	.53	.47	.45	.58
18	.82	.63	.60	.44	.42	.60
21	.19	.34	.49	.53	.70	.43
25	.64	.62	.57	.49	.48	.57
28	.24	.43	.42	.44	.68	.42
30	.67	.66	.58	.51	.43	.59
31	.58	.59	.53	.40	.40	.52
33	.27	.49	.53	.59	.52	.48
35	.33	.49	.61	.62	.78	.55
37	.19	.38	.41	.51	.60	.40
38	.08	.20	.24	.24	.35	.21
47	.79	.67	.53	.48	.43	.59
52	.19	.29	.42	.39	.65	.37
57	.80	.73	.75	.65	.70	.74
59	.77	.72	.71	.62	.63	.70
62	.07	.14	.28	.43	.72	.28
75	.78	.70	.61	.55	.60	.65
76	.68	.60	.60	.51	.40	.58
81	.79	.71	.62	.51	.47	.64
82	.24	.31	.32	.44	.45	.33
91	.22	.29	.44	.56	.73	.41
98	.78	.71	.68	.61	.42	.67
101	.63	.54	.53	.36	.42	.51
102	.16	.27	.37	.39	.55	.33

the eighty-five common items, the ones significant to the first year of French and the first year of Spanish respective, are classified and counted the results may be summarized as follows:

Class	French 1a–1b	Spanish 1a–1b	Total
I	6	8	14
II	10	8	18
III	7	7	14
Total	23	23	46

Performing the X^2 test of independence on these tabulations indicates that both the French and the Spanish enumerations could be drawn from a common population.

In this investigation the writers made comparisons between the distribution of significant items among the freshman and sophomore levels of study in French and comparison between the distribution of items for the French and for the Spanish freshman level of study. These comparisons have been made with respect to the three classes of study habit items which we have arbitrarily defined. Among the various courses for each language and between Spanish and French study at comparable levels of study, there are changes in the significance of the individual items. These changes with respect to the individual item are not analyzed in detail for two reasons. Some of these changes in the significance of an item from course to course are probably due to sampling factors. Other differences represent the demands of the level of a particular course and may not be of general significance in the study of language, that is, the precise content of various courses will vary somewhat according to the organization of instruction. As a consequence, there seems to be little basis for claiming that one particular study method is most appropriate to the first semester of study and some other study method is most appropriate to the fourth semester of study. Instead, the writers have been content to classify the items in terms of three broad categories and indicate the manner in which items within these categories are pertinent to the various levels of study; the more specific findings are included in the various tables.

TABLE VI.—ITEMS SIGNIFICANT TO THE SEVERAL GROUPS

Type of Items	Items Significant to both Freshman Languges	Items Significant to Freshman French only	Items Significant to Freshman Spanish only
I. Personal or Emotional			
A. Concentration	2, 35, 37		57
B. Anxiety		4	
C. Confidence	62	70	3, 59
D. General			81
II. Knowledge of Subject Matter or Content			
A. Pronouns	21, 38 (82)	19, (85)	33, 101†
B. Endings and Verbs		87*	25
C. Pronunciation		23	
D. Prepositions		88*	
E. Word Order	82	26, 85	
F. General	12, 52	71	28, 91,† 98,† 102†
III. Skill and Study Technique			
A. Time	11	67	
B. General; Insight	15, 18	83	75, 47
C. Rote Method	76	32	30, 31
Total	13	12	15

* Significant items unique to French Form.
† Significant items unique to Spanish Form.

SUMMARY

A study habits questionnaire has been administered to students enrolled in courses in French and Spanish. Two forms of the study habits questionnaire were prepared. The forms had eighty-five items in common. The French form had five items unique to it and the Spanish form had seventeen unique items. The French form of the questionnaire was validated against grades earned in four different semester courses covering the first two years of study. In addition the French form was validated against objective examination scores and the effect

of intelligence on the relationship was studied. The Spanish form was validated against grades earned in the first two semester courses of elementary Spanish. The results of this study may be summarized as follows:

1) It is possible to demonstrate that a large and useful group of study habit items are importantly related with the criteria we have selected as indicated by Tables II, III, and V.

2) It has been demonstrated, when the effect of intelligence has been held constant for a group of French students, that study habit items (including those relating to content difficulty) retain their predictive significance.

3) When the predictive items are classified as to whether they call for skillful technique, knowledge of the course, or attitude toward the course, the distribution of items among each of these classes remains fairly constant through the various levels of instruction and from the study of French to the study of Spanish.

4) Evidence is presented that the sophomores are less likely to report undesirable attitudes, difficulties, or procedures than the freshmen in the study of French.

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PERSONALITY TRAITS ASSOCIATED WITH ABILITIES. II: WITH VERBAL AND MATHEMATICAL ABILITIES

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1. THE NATURE OF THE EXPERIMENTAL DATA

A previous article[4] has studied the general possibilities in the relation of personality traits to abilities, exemplifying the theoretical alternatives[5] by an inquiry into the personality traits associated with (a) intelligence and (b) a special ability—drawing ability. The present report carries the study further, to other abilities, on the same group of one hundred twenty-three adult males (in the Army Specialist Training Program).

As before, the personality data consist of carefully controlled ratings on thirty-five personality trait clusters, known to be representative of the whole personality sphere.[2] The ability measurements consist of a measure of intelligence, on the Army Alpha Intelligence Test (Verbal and Numerical sections combined in a single total) and measures of mathematical and verbal ability on the Graduate Record Examination. The mathematical section of this test, like most other sections, is essentially a measure of 'level of attainment in knowledge and skills' in varied aspects of mathematics. The verbal measure is mainly a measure of width and correctness of vocabulary and sense of correct sentence structure.

Although the latter is labelled by the test designers 'Verbal Factor' it is in no sense a pure factor measurement. It is certainly not immediately identifiable with Thurstone's V factor, and inspection suggests that it may involve, to a lesser extent than V factor, but in appreciable loadings, W factor.[9] The patterns and relations of aptitude (constitutional endowment), ability (factor entities), and actual achievement (observed performance as measured by tests at a given time) in this field are not yet understood. The relations which we find here are those between personality and the last of the above—the actual attainment. Further research will be necessary to decide to what extent these relations arise through connections with the

genetic influences on the one hand or the interest and environment influences in 'ability' on the other.

2. THE RELATIONSHIPS FOUND

The correlations of the intelligence test and the two achievement measures were unexpectedly low; namely, 0.35 (mathematics) and 0.46 (verbal ability). Consequently it is scarcely surprising to find that the partialling out of intelligence does not reduce to zero the correlation between these special 'abilities' themselves or their correlations with many personality traits that have appreciable correlations with intelligence.

Two explanations are possible. We may assume that this particular test is not a very adequate test of intelligence and set ourselves further to partial out whatever remains in common to verbal and mathematical attainment, before seeking to deal with correlations due to these particular abilities alone. Most psychologists[1] would resent such cavalier dismissal of the Army Alpha, and indeed it cannot be judged worse than many tests which give well-behaved measures of intelligence in situations such as this one. Alternatively, we may accept the intelligence correlations, on the grounds: (a) That the correlation is in fact not low for adults, for it is well known that 'g' saturation of performances declines at the adult level[8,9] in a way explicable by the present writer's theory of fluid and crystallized general ability.[1] (b) That there may be common factors other than intelligence influencing these abilities and personality traits, e.g. character qualities, studiousness of temperament, length of education. One might expect, among the twelve primary personality factors, that, for example, G (Positive Character Integration) or K (Trained, Cultured Mind) would be involved.[3]

Granted that other general factors are involved, and that, from the look of the correlations listed below, they are personality factors, not merely something left over in mathematics and verbal ability alone, the two following investigatory procedures suggest themselves as most apt: First, one might throw the correlations of the abilities and the personality traits in with the general personality trait correlation matrix[2] and re-factor the whole thing. That is prohibitively laborious. Secondly, one might estimate the correlation of each of the two abilities with each of the twelve personality factors, by finding the multiple corre-

lation of the ability with those traits high in each factor (and low in any other). Each factor, beginning with the one most involved, could then be partialled out from the correlation of the ability with each personality trait, to see whether, in the end, there might be any specific correlation of a trait with an ability, apart from that due to more general personality factors.

The second course is in essence the one that we followed, but not by the exact, laborious procedure just indicated (for this study is intended only as a preliminary survey of the promise of the field of investigation). Until the personality factors are themselves confirmed by other research workers and the correlations with abilities given greater accuracy through averaging with those of further researches, attempts at precisely accurate analysis are not warranted. In the first place we looked to see what factor loading profiles, if any, in the original personality factor analysis[2] resembled the observed correlations of the same set of variables with the abilities. General intelligence (Personality factor B) first stood out clearly in this manner, and its major rôle was also confirmed by the actual correlation with an intelligence test. After intelligence had been partialled out, the remaining correlations were again inspected for correspondence to any of the remaining eleven personality factors. As stated in detail below, the next resemblance was noted with factor G. This and later factors could not be partialled out accurately because the correlation of the ability with the factor could not be estimated, by any reasonably short method, with accuracy.

Our approximation, as indicated above, consisted in estimating this correlation from a multiple correlation of the ability with a few variables high in the factor concerned and low in any other factor. The partialling out, apart from the initial partialling out of intelligence, was correspondingly approximate, for, since the correlations of the personality traits individually with the ability were all low, we retained the same denominator to the partial correlation formula throughout the thirty-five variables. This error is negligible: the main approximation resides in the estimate of the correlation of the ability with the personality factor.

The actual correlations found between personality traits and abilities are as shown below. The trait numbers are the same as in the original list,[2] but the descriptive titles are here cut to a

bare minimum. One notices first that the highest personality correlations in one ability are substantially the same, and on the same items, as for the other ability. These are for variables 2, 3, 4, 11, 12, 17, 27, 28 and 35. The signs and rank orders of these correlations have no resemblance to the factor loadings for any of the first six personality factors,[2] but they have a striking resemblance to the loading pattern for G. Partialling out G, on an estimated correlation of 0.4 with that factor, leaves an equally clear resemblance of the residual profile to K, with which the estimated correlation of the ability amounts to 0.3.

RESIDUALS AFTER PARTIALLING CUT INTELLIGENCE

Personality Cluster	Mathematical Ability (Intelligence partialled out)	Verbal Ability
1. Self-assertive	−.02	−.03
2. Intelligent, analytical	.33	.38
3. Wise, mature	.20	.21
4. Changeable, frivolous	−.14	−.23
5. Neurotic	−.08	.08
6. Hard, cynical	−.05	.00
7. Wilful, egotistic	−.07	−.11
8. Rigid, tyrannical	−.12	.00
9. Surly, hard	−.07	.00
10. Demoralized autistic	−.16	.00
11. Strong-willed, conscientious	.21	.28
12. Intellectual, wide interests	.23	.29
13. Insecure, infantile, hostile	−.04	.04
14. Anti-social, schizoid	−.06	.15
15. Cheerful, enthusiastic, witty	.09	−.16
16. Active, creatively unstable	.00	−.13
17. Character neurosis, psychopathic	−.14	−.19
18. High-strung, expressive	−.07	−.08
19. Spiteful, tight-fisted	−.03	−.03
20. General emotionality	−.13	−.12
21. Ascendant, expressive, widely interested	.04	−.04
22. Responsive, genial, sentimental	−.02	−.12
23. Facile, foppish, affected	−.07	−.01

Personality Cluster	Mathematical Ability (Intelligence partialled out)	Verbal Ability
24. Hostile, paranoid	−.11	.07
25. Aesthetic interests, independent	.06	.16
26. Restless, hypomanic	−.05	−.04
27. Infantile, demanding	−.13	−.17
28. Changeable, characterless	−.14	−.14
29. Psychophysically vigorous	.05	.10
30. Adventurous, lusty	.06	.00
31. Sociable, hearty, not shy	.00	−.26
32. Opposite of melancholic, hypochondriacal	−.04	−.02
33. Tough, solid, talkative	.00	−.20
34. Imaginative, introspective, constructive	.08	.19
35. Smart, assertive	.17	.11

If we now partial out the influence of G (Character Integration) and K (Trained, Cultured Mind) by the tolerable approximation mentioned above, we find, in the first place, that apart from some correlation with variable 2 we seem to have got rid of whatever is common to verbal and mathematical ability, in the way of personality associates. Secondly, as far as mathematics is concerned we seem to have got rid of any indubitably significant correlation whatever. Only some suggestions of correlations (falling between one-and-a-half and four times the probable error) remain, for variables 2, 8(−), 20(−), 24(−), 29(−), 34 and possibly 16 and 30. These traits are (8) Adaptable, friendly, (20) Unemotional, content, (24) Trustful, reasonable, not sadistic, good-tempered, (29) Absent-minded, languid, slow, (34) Labile, intuitive, careless of material things.

The factorial and psychological consistency of this grouping gives us some little confidence in these indications, even though the individual correlations are not significant, but we pursue the inquiry around these variables rather to explore hypotheses for the guidance of further research than in the hope of establishing unquestionable facts. The above correlations with variables indicate correlations with factors F, H and E(−) only. By assuming correlations of mathematics with these personality

factors of 0.2, 0.2 and −0.1, respectively, and partialling out, one removes any remaining correlations, i.e. the pattern of loadings is consistent with the action of these three factors weighted in that order.

Verbal ability shows more definite personality associations after the influence of character and training (G and K) have been allowed for. There are significant correlations with 2, 5, 14, 15(−), 31(−) and 34, and suggestive ones with 4(−), 10, 13, 22(−) and 33(−). These indicate correlations with factors A(−), F(−) and I. There seem to be no other factors which either alone or in combination can be made to simulate by the loading pattern the pattern found here (except that the other schizothyme factors, H and L, can be substituted with little trouble for A). By assuming a correlation of verbal ability of 0.5 with I factor, −0.35 with F factor and −0.25 with A (or higher with H) factor and partialling out, on the basis of factor loadings for personality traits used throughout this article,[2] one reduces the correlations practically to zero. That is to say, the combined profile for these three factors, weighted as indicated by these correlations, equals the loading pattern found above (after extraction of B, G and K) for verbal ability and personality traits.

After the removal of the correlations due to the above personality factors no one of the thirty-five personality variables has any specific correlation with the abilities, except for a slight specific for variable two (positive).

3. SOME HYPOTHESES ON CAUSAL CONNECTIONS

That G, the general character integration factor, showing itself in persistence and stability, and K, the factor which seems to represent exposure and responsiveness to cultural influence, should be the chief influences, over and above intelligence, in determining achievement in these two typical school subjects, should surprise no one. The result is nothing more than a confirmation of common sense observation, susceptible now to formulation in more precise and quantitative psychological concepts. That no other personality factors are shared by both, such as cyclothyme-schizothyme (A factor) tendencies, or surgency (F factor) or general emotionality (C factor), in any extent

detectable by a first approximate study, is, however, something that could not be presaged.

The next question for research is to find whether the character (G) and cultural (K) factors are more important in some attainments than others, and to what extent.

Regarding the connections of verbal ability, the greatest surprise to 'armchair' theorists will probably arise from the indication that it is connected with low F (Desurgent, Melancholy) and low A (Schizothyme tendency), i.e. with lack of sociability and talkativeness and with traits that used to be included in the confused conglomerate known as 'introversion.' To the theorist in learning it may seem a paradox that the chief means of communication should reach a higher level with those who communicate least. However, there are many facts familiar to the observant clinician which witness to the truth of this finding, and it may be necessary here only to sample a couple of observations from independent fields. Anyone who has taught both American and English college students receives a distinct impression of unmistakably greater average extraversion in the former and of greater vocabulary and skilled language usage in the latter. Somewhat oblique, independent, evidence may also be found in an interesting recent observation of Thurstone* that high verbal ability—V factor—is actually a contra-indication for success as an airplane pilot. If common observation can be relied upon, the typical pilot of the air forces is a characteristically surgent (cheerful, quick-witted, social, placid) and cyclothyme (easy-going, adaptable, adventurous) individual, who, according to our correlations should be below average in verbal ability (V, not W) compared with those of equal intelligence and opposite temperament. However, in this last instance the connection of verbal ability with I factor (nervous emotionality) may be the more powerful influence accounting for the low verbal ability of good pilots. Evidently Admiral Byrd and Antoine de Saint Exupéry must be counted exceptions to their profession, in this as in other respects.

The final common observation which harmonizes so completely with our findings is that the greatest lovers of language—the poets—have notoriously corresponded to this formula: sensitive

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* Personal communication to the writer.

(I factor), melancholy (F(−) factor), aloof-withdrawn (A(−) factor). Examples are too numerous to mention and we need illustrate only with such prototypes as Tennyson, or Emily Dickinson whose social behavior caused her to be aptly called by a biographer "the superbly articulate inarticulate." Examples could be found with equal ease among prose writers, especially those who are famous for style, and one may wonder, in contemplating also dramatists of great verbal skill, whether the exceptional vitality of Hamlet may not in part be due to its being an exercise in projection by its author.

Considering only our own research population, the most obvious hypothesis to explain the paradoxical connection is that the less sociable a man is, the more he is likely to read. Unless he is a Cambridge don, or meets at the inmost shrine of Greenwich village, the companions of his books will have better vocabularies than those he sits with over supper. But in some cases the withdrawal follows rather than precedes the reading interests, and it may be that the temperament in some more direct fashion sensitizes to interests in words and ideas rather than action and people. It would be interesting also to explore the rôle as possible intermediaries of certain factors found in musical appreciation, which may connect with F and which might lead to increased verbal proficiency not through any sensitive withdrawal but through inward listening to the music of words.

Because the nature of I factor, owing to the recency of its discovery,[3] is still largely unknown, hypotheses as to the cause of its appreciable rôle in verbal achievement would be premature. The factor loads the traits: soft-hearted, intuitive, infantile, nervous, emotional and emotionally dependent. The present writer has given it the descriptive label 'Sensitive, imaginative, anxious emotionality,' and its intrinsic nature has already been linked speculatively with anxiety hysteria, feminity, sex hormone balance, hyperthyroidism and traumatic nervous conditions. Contingently an hypothesis of sex hormone balance (androgen-estrogen relationship) seems most likely, for the factor stands out quite clearly in a population exclusively of one sex. One can only point to other evidence in the same direction, without explanation; namely, that mental testing has now conclusively shown superior performance in verbal abilities (relative to general

intelligence) among women; that girl infants have a larger vocabulary than boys; that the novel presents one of the few realms in which the cultural performance of women easily rivals that of men.

The associations we have found with mathematical ability (not N, calculating skill) additional to intelligence, character integration and general education; namely, with surgency, cyclothyme tendency and low dominance, though slight, are, in in the main, in agreement with observation of outstanding personalities in the field and susceptible to psychological explanation. The individual lacking in social dominance and manifesting the lack of self-confidence which the questionnaire shows to exist on the introspectible side of this pattern, is both less likely to get out of patience with the rigid, intractable, deliberateness of mathematics and more likely to welcome the comforting certainty of the all-embracing system. For the high dominance individual, as our correlations show,[3] is notably headstrong and impatient, while the low dominance individual seeks something greater than himself on which he can lean. Newton and Pascal, with their fine character and resigned humility, were thus nearer the human norm for mathematical performance than was Gallois. If the latter had survived his youthful duel it may be questioned whether he would have continued to make a name for himself in mathematics, rather than in, say, politics. Both of the former, in accordance with the essence of this explanation, readily substituted the certainty of religion for the certainty of mathematics. They turned from social conflict to calmer, more orderly realms, which also sustained them with infallible foundations.

The suggestion that cyclothyme tendency is slightly associated with mathematical ability certainly runs contrary to some clinical notions to the effect that the mathematician is a schizoid, withdrawn individual. Nor can one point to any obvious preponderance of cyclothyme over schizothyme temperaments among prominent mathematicians. However, a good case could be made for some preponderance of pyknic body build. Further, it could well be questioned whether the mathematician's liking for realistic abstraction is not being confused, by those who call the mathematician schizoid, with the autistic, emotional, self-centered 'abstraction' of the true schizoid. The egotistic autism of the schizoid might well be expected to make him dis-

inclined to get interested in the inexorable, highly realistic laws of mathematics. Whereas the mathematician may withdraw from people in order the better to think, the schizothyme resorts to the world of 'thought' in order the better to withdraw from people and brute facts. If, as Kretschmer argues, we may expect to find the scientist more cyclothyme and the philosopher more schizothyme, the mathematician might be expected to fall somewhere in between.

Similarly, the correlation which we find between surgency and mathematical ability is not one which would spontaneously suggest itself from common observation. High F factor is known[6] to be strongly associated with 'fluency of association,' which appears in all material, including verbal material (Thurstone's W) and which appears to be the essence of what is popularly called imagination[7] when intelligence is partialled out. The value of great fluidity of imagination, of ready rising of associations from all angles, to success in mathematics, can readily be seen, but it is not so easy to see why it is not also useful to verbal performance. However, the verbal ability of this article (V factor) is one of vocabulary and adherence to style and can reach high levels of excellence without requiring departure from socially-conditioned, habitual ways of thinking. Indeed the verbal habits are often preventive of thinking off the track, so that a mathematician can often say more original things in a couple of formulae than a philosopher succeeds in saying in a whole book. Biologically and socially considered, mathematical thought is among the most remote, strange and qualified of mental processes that the ordinary person can be called upon to undertake. It is no accident, our analysis suggests, that an eminent mathematician wrote *Alice in Wonderland,* with its cyclothyme gentle warmth and its magnificent display of F factor.

4. SUMMARY AND CONCLUSION

By an approximate process of successive partialling out of known personality factors from the observed correlations of mathematical and verbal skills with a wide variety of personality traits it has been shown, first, that these abilities have in common and in about equal amounts, the factors: B (General ability), G (Character integration) and K (Trained, cultured mind—possibly a factor of length of general education). The order of magnitude

of correlation with these factors is roughly, 0.45, 0.4 and 0.3, respectively; the first being confirmed by an intelligence test, but the latter being rough estimates from multiple correlations on inadequate data.

Partialling out, on the basis of these estimates, reduces most of the correlations of individual personality traits with abilities to zero, but some special correlations remain which are consistent with the following factor correlations: (1) A slight correlation of mathematical ability with personality factor F (Surgency) (0.2), H (Rhathymic Cyclothymia) (0.2) and E (Dominance) (−0.1). (2) More appreciable correlations peculiar to verbal ability with I (Nervous Emotionality) (0.5), F (Surgency) (−0.35) and A (Cyclothymia) (−0.25). There then remains only one specific personality variable having any correlation with these abilities—variable No. 2, a cluster of 'cleverness, analytical mind.'

The approximations adopted are consistent with the present accuracy of original observations in this field and with the limited purpose of this article, which is to explore in a preliminary way an entirely new field—the interrelation of abilities and personality traits—and to state, on the basis of these specific data and of more general observations, some working hypotheses which may guide further research. The general manner in which the profiles of loadings found in pure personality research persist in these correlations with abilities, offers, incidentally, additional confirmation of the real existence of the personality factors[3] as functional unities.

The rather common assumption of past educational psychometrics that when one partials out what is common to a group of ability-achievements one is only partialling out intelligence, or, that, if several general factors are found, they are to be considered 'ability' factors, is shown to be unjustified. When one considers 'abilities' in company with a wide range of personality variables, their affinity to broad personality factors is revealed. Ability tests given under special conditions which tend to bring out their pure natural aptitude character may resolve largely into factors of pure ability modality; but tests having more the characters of skills and achievements, or temperamental facilities, are likely to be better interpreted by being experimentally associated with a representative set of personality variables, when

the factors emerging will be found to have rather the character of 'wholistic'[5] factors, involving dynamic and temperamental aspects of behavior.

If our hypotheses are correctly rooted in the data, the interrelations of abilities and personality traits proceeds causally in both directions, and with direct and indirect connections. Temperamental interests and aversions develop abilities in their service. Abilities favor certain kinds of dynamic adjustments, e.g. intelligence favors the development of good moral goals and adjustment habits. But in other cases the determination seems to be more direct, and possibly through a single gene affecting at once both temperamental traits and abilities, e.g. the connection of verbal ability with I factor (Sensitive, anxious emotionality) and possibly with schizothyme tendency.

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RATE OF VISUAL PERCEPTION AS A FACTOR IN RATE OF READING

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That there are wide individual differences in rate of reading is well known. Perhaps a fair estimate of the average rate of the average high-school senior is two hundred fifty words per minute, as based upon published data. The standard deviation of the distribution of rates for a given selection is about fifty words per minute. Thus, given a mean of 250 and an SD of 50, and assuming a normal distribution, sixteen per cent do not exceed two hundred words per minute, and a like percentage read three hundred or more words per minute. By the same reasoning about two per cent do not exceed one hundred fifty words and about two per cent exceed three hundred fifty words. (Actually, such distributions are usually somewhat positively skewed.)

It goes without saying that the question of the factors that contribute to these large differences is of first-rate importance in education and psychology. Perhaps the so-called peripheral factors—perceptual span and fixation time and other eye-movement data, visual aberrations, rate of visual perception, and the like—have been investigated with greater care than any of the others. Despite the fact that our knowledge of these factors is relatively complete there is a lack of unanimity as to what they mean. This is especially true of eye-movement data and rate of visual perception.

Eye-movement data are perfectly correlated with rate of reading. Yet from the time our knowledge of eye movements was fairly well rounded out the prevailing tendency has been to regard these 'mechanics of reading' as symptomatic rather than causal. Perhaps the question should be raised as to whether they must be one or the other. It is thinkable that one pupil may exhibit poor eye movements because he cannot apprehend quickly, or much at a time, and that another may be a clumsy reader because he has not developed good eye-movement habits. Conceivably faulty eye movements may be causal for one pupil, symptomatic for another, and both for still another. Wherever

there is habit there is a chance for bad habit. It is in keeping with what is known about such matters to suppose that some potentially fast readers read slowly because of slovenly eye-movement habits.

On the other hand, it is supposable that there are large individual differences in rate-of-reading aptitude. Material differences among individuals appear to exist with respect to every measurable trait. It seems reasonable to suppose that the rate of effective reading in some may be severely limited by slow mental reactions. That there are substantial individual differences in quickness of mental reactions hardly seems debatable. The rate of reading of everyone must ultimately reach a physiological limit determined by the rate of his mental processes; however, within the range of speed normally attained such a limit may possibly be of no practical importance.

We may inquire as to whether, within the range in rate normally found among mature readers, the speed of some of the slow readers is limited, at least from the standpoint of training procedures now in use, by slow mental reactions. Can it be shown that as between slow and fast readers, as at present constituted, slow mental reactions contribute to slowness in some? Or must we assume that slow reading is always and exclusively the result of poor teaching and poor and remediable reading habits?

For practical purposes the sensory processes may be eliminated, assuming there are no disabling defects. It is known from independent evidence that the eye is capable of working faster and of taking in at reading distance larger impressions than it actually does in reading. That is, retinal time is only a fraction of fixation time and amount that can be seen in a single fixation exceeds by a wide margin the span in reading.[8] Thinking-time and perceiving-time may be limiting factors, at a practical level. Thinking-time, as measured by speed of association, has been found to bear a positive relationship to reading rate,[1,7] as has also rate of perception.[3,4,6] It is of perception-time as a factor in reading that the present article treats.

HISTORICAL INTRODUCTION

In 1922 Gates reported for one hundred thirty-five highly selected pupils, Grades III to VIII, correlations between reading scores

(composite of nine tests) and spelling, on the one hand, and various measures of rate of visual perception, on the other.[3] One group of measures was designed to test the ability to detect small differences between pairs of (1) drawings, (2) groups of six digits, (3) nonsense syllables, and (4) words. Another group was designed to test the "ability to distinguish one printed element from several others of varied resemblance," featuring (5) geometric figures, (6) capital A's, (7) groups of letters containing both K and I, and (8) digits. Also utilized were a test of (9) word recognition and (10) a proof reading test. Some of the correlations obtained are as follows:

Test.....	1	2	3	4	5	6	7	8	9	10
Reading....	.15	.14	.27	.39	.16	.14	.04	.11	.47	.45
Spelling....	−.04	−.05	.35	.55	.14	.17	.04	−.03	.63	.39

All the foregoing correlations are averages of coefficients computed separately for each of the six grades.

In a later investigation, 1926, Gates administered certain of the foregoing tests, or tests similar to certain ones of the foregoing, to a group of ninety pupils, Grades III and IV, and to a group of one hundred forty-four pupils, Grades IV to VII, and computed separate correlations for the two groups.[4] He obtained a coefficient of .62 (average for the two groups) between detecting small differences between pairs of words and composite reading (average of three tests); of .40 between detecting small differences between paired groups of digits and composite reading; of .59 between word selection and composite reading; of .03 between selection of geometric designs and composite reading. Correlations between these same tests of visual perception and spelling are comparable to those reported between them and reading.

Gates obtained fairly high intercorrelations among word perception tests, and between word perception tests, on the one hand, and reading and spelling, on the other. Incidentally, holding test intelligence constant by partial correlation did not appreciably lower the obtained relationships. The other tests of visual perception failed to correlate appreciably with reading, with word perception, or with each other. The latter finding prompted Gates to conclude against there being "any such thing as 'general visual perception.' Rather there are abilities

to perceive words, digits, geometrical figures, etc.; each of which is relatively independent of other perceptual abilities."[3]

Sister Mary has published the results of a similar investigation on a group of sixty-two fourth-grade and forty-eight fifth-grade pupils.[6] In Test 1 the pupils were required to detect a small word common to four larger nonsense words per row. Tests 2, 3, 4, and 5 required the selection of words, groups of numbers, groups of letters, and drawings, respectively, as 4351: 4531 4351 5341 5431, in which the pupil checked the group among the four at the right corresponding to the group at the left. Tests 6, 7, 8, and 9 consisted of pairs of words, drawings, and paired groups of numbers and letters, respectively, some of which were alike and some different. The pupils were required to indicate similarities and differences. They worked against time in all tests. The score on the first five tests was number right; on the last four, the number right minus the number wrong. She obtained for each grade the correlations between the Stanford Achievement, Sangren-Woody, and Gates reading tests, on the one hand, and the various visual perception tests, on the other. These correlations averaged for the three reading tests and the two grades together with the reliability coefficients of the visual perception tests are as follows:

Test	1	2	3	4	5	6	7	8	9
Reading	.48	.63	.37	.60	.02	.73	.21	.45	.23
Reliability	.57	.76	.70	.59	.63	.48*	.55	.56	.36

* The reliability reported for Grade IV is .76; that for Grade V, .20. The latter appears to be a typographical error. The coefficient .48 is an average of the two coefficients as given.

Her coefficients between reading and perception tests are corrected for attenuation. In view of this fact it may be said that the relationships obtained by her are of about the same magnitude as those obtained by Gates, for comparable tests.

PROCEDURE

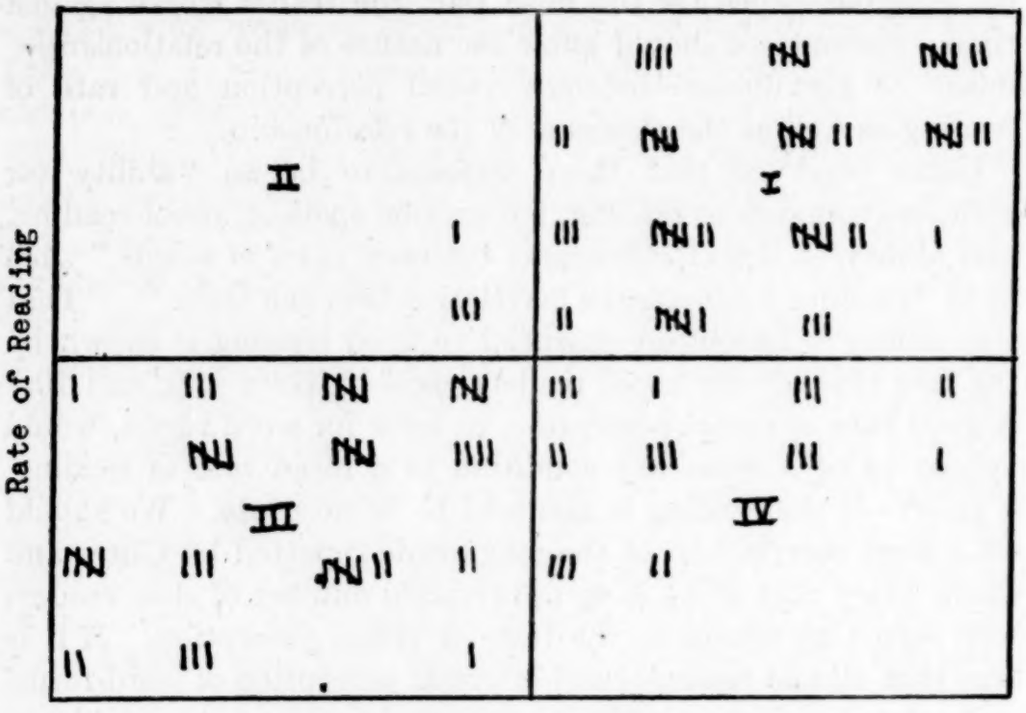
The importance of the problem under discussion is such as to make further investigation indicated. The number of cases used in the three investigations recounted above is relatively small, although this is not especially serious since the results are in close agreement in so far as the tests are comparable. Two

other reasons justify further work. First, the reading tests used measure several factors such as word meaning, rate, and comprehension; however, the rate factor is probably large in some of the tests designed to measure other functions—comprehension, for example—since for the most part the reader works against time. Second, we should know the nature of the relationship—linear or curvilinear—between visual perception and rate of reading as well as the closeness of the relationship.

Gates observed that there appears to be an "ability (or abilities) common to reading, recognition spelling, proof-reading, and ability to detect differences between pairs of words," such as to "produce a substantial correlation between them." "That this ability is absolutely essential to good reading is shown by the fact that all our rapid readers excel in Tests 4, 9, and 10." A good rate of visual perception, at least for word forms, would appear to be a necessary condition to a rapid rate of reading, *a priori*—if the reading is assumed to be accurate. We should infer from correlations of the magnitude reported by Gates and Sister Mary that there is an appreciable number of slow readers who earn high scores on the tests of visual perception. If it is true that all fast readers excel in visual perception of word-forms and related objects, we should expect a curvilinear relationship between rate of reading and rate of visual perception. Of course, in a large random sampling we should anticipate that there are some fast readers who will make low scores on rate of visual perception. In fact, with tests of the reliability of those here used, we should expect the number to be appreciable. But there should be a significant departure from linearity. One of the objects of the present investigation is to make this determination. If there is a significant departure, the suggestion that rate of visual perception amounts to an aptitude for rate of reading might be entertainable.

Should it turn out that the scores plot as indicated in the diagram on page 492, the relationship might conceivably turn out to be quite significant for instruction in reading. It is supposable that the students falling in Quadrant IV might respond more readily to reading instruction designed to improve speed than those in Quadrant III, who are more or less equal to IV in existing reading rate—since they have demonstrated excellence in perception of word-forms. It is thinkable that

they read slowly because they failed to learn to read rapidly; and that pupils in Quadrant III read slowly for the reason, partially at least, that their perceptual reactions are slow. The first step is that of determining if such a relationship exists.



In the present investigation both forms of the Chapman-Cook Speed of Reading Test were administered to five hundred seventy pupils in Grades IV, V, and VI, so selected as to give a representative cross section of pupils in a city of about 60,000 inhabitants. Six tests of visual perception were also administered. Three of these—word selection, digit selection, and letter selection— were taken from Sister Mary's battery previously cited. Each of the tests contained fifty items arranged in the following form:

stuvw: sfuvn strnw stuvw efuvw

in which the pupil was instructed to cross out the group among those at the right corresponding to the group at the left. The words increased in length, gradually, from five to ten letters; the digits increased from groups of two numbers to five; the letters from three to six. The size of the unit was constant within each row. The other three tests consisted of paired

digits, paired letters, and paired drawings, each of fifty pairs. The groups of digits and letters varied from three numbers, or letters, to eight. Some of the drawings were also taken from Sister Mary's battery.

The pupils were allowed two minutes for the execution of each of the six tests. This proved to be a bit too liberal for the word selection test; about five per cent finished this test. Scarcely anyone finished any of the others.

All the tests were scored in terms of number right. The number of errors was rather small, being 3.9 per cent of total responses. The scoring procedure adopted is an arbitrary one. There is independent evidence to the effect that a wrong response requires as much time as a correct one. One might justifiably claim that in a test of this kind the score should be $R + W$. However, since we may assume that in group-testing situations such as this there will be large differences in the care with which students work, $R + W$ would appear to give careless students an undue advantage. The test papers for the fifth grade were scored three different ways: R, $R - W$, and $R + W$. The composite scores derived by the three methods correlated with the reading-rate scores to the extent of .43, .43, and .37, respectively.

RESULTS

The correlations obtained between the visual perception test scores and the Chapman-Cook rate of reading scores are of about the same magnitude as those obtained by Gates and by Sister Mary for other reading tests. A correlation of .75 was obtained between the two forms of the Chapman-Cook test, giving a reliability coefficient of .88, by the Spearman-Brown prophecy formula, for the two forms combined. The correlation ratios of reading rate (y) upon rate of perception (x); and the r's between reading rate and various tests of rate of perception are given in Table I. A significant difference between η's and r's is taken as evidence of a significant departure from linearity. Presumably, we are here concerned with the differences between η_{yx} and r rather than with those between η_{xy} and r. The values of η_{xy} are also given in Table I, although the concern here is more with the values of η_{yx} since we are interested ultimately in the possibility of predicting improvability in reading rate upon the basis of rate of perception.

TABLE I.—CORRELATIONS BETWEEN RATE OF VISUAL PERCEPTION TESTS AND CHAPMAN-COOK SPEED OF READING TESTS

Tests	η_{yz}	η_{xy}	r
1. Word Selection and Chapman-Cook	.55	.51	.51
2. Digit Selection and Chapman-Cook	.44	.40	.36
3. Letter Selection and Chapman-Cook	.55	.47	.43
4. Paired Digits and Chapman-Cook	.39	.38	.35
5. Paired Letters and Chapman-Cook	.25	.28	.22
6. Paired Drawings and Chapman-Cook	.09	.06	.05
Composite (unweighted) and Chapman-Cook	.49	.50	.45

The coefficients in Table I are averages of the coefficients obtained separately for each of three grades. For example, $r = .51$ (correlation between Word Selection and Chapman-Cook) is the average of separate coefficients computed for Grades IV, V, and VI.

As noted above, Sister Mary reported mean reliability coefficients of .76, .70, and .59, respectively, for Tests 1 to 3. The writer has no information regarding the reliability of Tests 4 to 6. The relatively high intercorrelation between Tests 4 and 5, as shown in Table II, suggests reasonably satisfactory reliability.

TABLE II.—INTERCORRELATIONS AMONG RATE OF PERCEPTION TESTS

	2	3	4	5	6
1	.56	.63	.58	.52	.36
2		.59	.60	.43	.38
3			.62	.51	.32
4				.74	.50
5					.52

The results of the three previous investigations, of Gates and Sister Mary, and of the present investigation are in agreement in showing fairly substantial correlations between rate of reading and tests of word, letter, and number selection. Gates and Sister Mary also obtained comparable results for tests of ability to detect small differences between pairs of printed words. No test of this kind was used in the present investigation. The correlations obtained between rate of reading and paired digits

and between rate of reading and paired letters are, in general, somewhat lower than those between word selection, digit selection, and letter selection, on the one hand, and rate of reading, on the other, in all four investigations. This poses an interesting question, especially in view of the fact that the reliability of this form of test is comparable with that of the other form (selection), for the same content. It may be that mental set was less uniform from subject to subject in paired digits and paired letters than it was in selection of digits and selection of letters. One subject may have aimed at high accuracy, examining the individual letters or numbers of the respective pairs; another may have taken a quick glance at the two visual patterns, without minute analysis. Such differences in mental set might well affect the correlations between these two tests and rate of reading scores without affecting either the reliability of the tests or the correlation between them—if such differences in mental set were common to both tests.

The correlations obtained between rate of reading scores and paired geometric designs are negligible, according to all the investigations. It will be recalled that Gates took this finding to indicate that there is not such a thing as general visual perception. There are instead, he suggests, abilities to perceive words, letters, digits, geometric figures, and so on, each of which is relatively independent of the others. Visual patterns comprise the content of all the foregoing tests. All except the designs are standard patterns, including the words encountered in the reading tests, and may be presumed to have been practiced a great deal. Were standard geometric designs used and were they likewise made the object of specific instruction in school for from four to six years, it is thinkable that they likewise would correlate with rate of reading scores to as high a degree as do the other tests. Perhaps in such an event the reliability of designs tests would also improve.[5] It is also noteworthy that digit selection and letter selection correlate with rate of reading tests to an extent comparable with word selection. The instance of lower correlations in the case of paired digits and paired letters has already been commented upon. It would hardly seem true that the abilities involved in perceiving words, letter, and digits are separate abilities—if there is a common mental set and a common mental reaction to be made. If 'ability' be interpreted

strictly to mean performance, without any connotation of capacity, perception of geometric designs may be regarded as a separate ability, in the sense that it does not correlate with the other abilities. However, the low correlations between perception of designs and perception of words, letters, and digits may be due to differential practice, not to differences in innate capacities involved.

One of the objects of the present experiment was to determine whether or not there is a significant departure from linearity, as indicated, for example, by significant differences between η's and r's. For those tests that correlated to a moderately high degree with rate of reading, in this and other investigations—word selection, digit selection, and letter selection (Tests 1, 2, and 3, Table I)—the differences between η_{yx} and r are significant at the one per cent level.*

Fast, accurate readers should be able to perceive words, and possibly letters and digits, rapidly and accurately. All of the subjects of this experiment who earned high Chapman-Cook scores did not earn high scores on the tests of word, letter, and digit perception, although the great majority of them did so. On the other hand, the number of the slow readers earning high scores on the perception tests was proportionately greater.

It seems reasonable to suppose, as noted earlier, that some pupils who have potentialities for reading well at a fast rate read slowly because they learned to read slowly; and that others read slowly because their mental processes are slow. However, granting the soundness of these suppositions, it might be necessary to train all readers to something close to a physiological limit in order to demonstrate it.

It appeared that differences in rate of visual perception might make for differences in potentiality in reading rate. Accordingly, tests of rate of word selection, letter selection, and digit selection, similar to Tests 1, 2, and 3, Table I, but more difficult, were administered to the freshman class (University of Iowa) as a part of the entrance examinations battery, together with Blom-

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* The test used was $F = \frac{\eta_{yx}^2 - r^2}{1 - \eta_{yx}^2} \times \frac{N - m}{m - 2}$, where N = the total number of cases, and m = the number of classes of the x-variable in the scattergram. The F-table is entered with m − two degrees of freedom for the larger variance and $N - m$ degrees of freedom for the smaller variance.

mers'[2] rate of comprehension of reading tests. About two hundred freshmen who fell in the lower half in rate of reading were selected randomly for special training in reading. This training was administered during the school year 1944–1945. The program of instruction and the results will be described in a later article. Suffice it to say that the gains, as indicated by scores on various reading tests, were rather substantial—if they may be taken at face value.

Certain preliminary calculations of the results of this reading program are pertinent to the present discussion and are here reported. Correlations have been computed between gross gain in reading rate and initial scores on the rate of visual perception tests. These were found to be negligible. Thus, for the tests of visual perception used, for the range of gains achieved, for the procedures employed, etc., it may be said that rate of visual perception gives no prediction as to improvability in reading rate.

The fact remains that rate of reading and rate of visual perception of words, letters, and digits are related abilities; and, in view of the reliabilities of the tests used, probably rather highly related. If we grant that improvability in rate of reading is unrelated to initial rate of visual perception, we do not thereby prejudice the case relative to the possibility that training in perception of words, numbers, or digits, may lead to improvement in reading rate. Nor would it argue, necessarily, that basic training in visual perception—as in words, letters, digits and other visual forms—might not profitably be used as a supplement to training in reading rate. In so far as the data at hand are concerned rate of reading may well be causal to rate of visual perception; or it may be either cause or resultant, in the sense that training in either may affect the other; or it may be that the two phenomena are related because of common training.

CONCLUSIONS

1) This investigation has corroborated Gates and Sister Mary in finding evidence of a significant relationship (in the neighborhood of .50) between rate of reading and rate of visual perception as measured by tests of word selection, letter selection, and number selection. It also agrees in finding a lower relationship between rate of reading and discrimination of groups of paired

digits and paired letters; and in finding a negligible relationship between rate of reading and discrimination of paired designs.

2) Evidence obtained suggests that the relationship between rate of reading and rate of visual perception is non-linear, at least with respect to the difference between η_{yx} (rate of reading upon rate of perception) and r—which is the difference with which the foregoing is concerned.

3) In the present investigation no relationship was found between rate of visual perception and improvableness in reading rate. This finding is, of course, relative to the conditions of this investigation.

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RELATIONS BETWEEN ABILITY AND SOCIAL STATUS IN A MIDWESTERN COMMUNITY. II. SIXTEEN-YEAR-OLD BOYS AND GIRLS

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The present paper reports results of tests given to sixteen-year-olds in a typical Midwestern community. A previous paper* reported results of tests administered to all ten-year-old children in this same community. The purpose of this study was to find out how differences of ability are related to social status. A further paper will analyze the changes which appear with age in an attempt to determine the educative effect of the different social environments in which these children live.

THE COMMUNITY

Midwest, the community in which this study was made, is a typical midwestern community.

Included in the study were families living in the county seat, Midwest, and its surrounding rural trading territory. The total population of this area is ten thousand, about six thousand of whom lived in the city of Midwest at the time of the 1940 Census.

As in other communities, the citizens of Midwest are members of a social hierarchy. They place themselves on a social scale, above some people and in most instances below others in the community.

In studying the social hierarchy of this community the 'social status' method was employed. By this method the people of a community are studied with respect to their social participation—Who associates with whom? Which individuals and which groups are placed at the top, middle, and bottom of the social scale by the people in the community?

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* "Relations between Ability and Social Status in a Midwestern Community. I. Ten-Year-Old Children." Havighurst, R. J., and Janke, L. L., *J. Ed. Psych.* 35, 357–396 (1944).

Following the procedure of the social status method, Professor Lloyd Warner and his students placed the families of the boys and girls included in this study on a scale of social classes.*

TESTING PROCEDURES

As was the case in the study of the ten-year-old children, all of the sixteen-year-olds were tested individually by one of us (LLJ).

In the present study, the group to be tested consisted of all the boys and girls in Midwest and its surrounding rural territory who were born in the calendar year 1926. Birthdates were secured from school records and checked against birth certificates. Records of birth certificates and elementary-school records were also used in locating sixteen-year-olds who were out of school.

In this age group there were a total of one hundred forty-seven individuals. A total of one hundred twenty persons were tested. Five of these are not included in the tables because there was insufficient knowledge of their families to permit placing them in a status group. Eighteen who were out of school came in to be tested, and were paid fifty cents an hour for taking the tests. Of the twenty-seven who were not tested, all but one were out of school. The field-worker called on all the twenty-seven who were not tested, and in some cases made several calls. She made definite appointments with ten persons who did not meet the appointments.

This experience indicates that it is extremely difficult to test everybody in a given age group after the age of fourteen, when children begin to drop out of school. However, it was possible to make a judgment as to the effect of the omissions on the average scores, because there were Otis Intelligence test scores in the school records of seventeen of the twenty-seven persons who were not tested. This matter will be discussed later.

TESTS USED

A brief description of each test used follows:

1) The Revised Stanford-Binet, Form L, was used as a verbal test of intelligence.

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* Characteristics of each of the five distinct social classes found in Midwest by these investigators are described in detail in the first paper, where a more complete account of the community will also be found.

2) The Performance Scale of the Wechsler-Bellevue Adult and Adolescent Scales was used as a performance test of intelligence.

3) The Iowa Silent Reading Test, New Edition, Advanced Form AM was chosen to test reading ability. The Elementary Form of this test was administered to ten individuals who were out of school and who had not completed more than eight school grades.

4) The Minnesota Paper Form Board, Revised, Form AA. This test was chosen as a means of measuring ability to perceive spatial relations. High scores in this test are said by its authors to be predictive of success in engineering and mechanical occupations.

5a) The Minnesota Mechanical Assembly Test, (Modified). This test was found by its originators to give a very good prediction of mechanical ability. For this study we used our own modification of the test, which consisted of the long form of the Minnesota test from which items which have become obsolete, and items which seemed to depend to a considerable extent on strength of fingers or wrists, were omitted. The following items were retained:

Box A.—Expansion nut, hose pinch clamp, linked chain, bottle stopper, push button doorbell, bicycle bell, Corbin rim-lock.

Box B.—Safety razor, monkey wrench, ringstand clamp, test-tube holder, spark plug, electric plug and wire, handle for iron.

Box C.—Die holder, pliers, electric-light socket, wing nut, glass drawer knob, rope coupler, kettle cover knob, lock nut, pet cock, hose clamp, pencil sharpener, air gauge valve.

5b) The Chicago Assembly Test for Girls. The only test of mechanical ability for girls, the IER Assembly Test,* appeared to be inadequate for our purposes. Consequently, we devised a test designed to measure the skill of a girl in working with her

* Toops, H. A. *Tests for Vocational Guidance of Children Thirteen to Sixteen.* Contributions to Education, Teachers College, Columbia University, No. 136, 1923.

hands. This test consists of twenty short tasks.* (1) Stringing beads, (2) Assembling a cabinet door knob, (3) Assembling a simple pencil sharpener, (4) Assembling a kettle cover knob, (5) Attaching electric wire to plug, (6) Identifying sewing tools, (7) Identifying textile materials, (8) Stick printing, (9) Clay modeling, (10) Weaving, (11) Cutting along a line with scissors, (12) Cross stitch, (13) Outline stitch, (14) Pinking, (15) Basting, (16) Hemming, (17) Bias binding, (18) Embroidering a design on toweling, (19) Drawing a flower, (20) Tracing a design.

6) The Porteus Maze Test was administered, but results failed to indicate sufficient differentiation between sixteen-year-old subjects to be included in the study.

RESULTS

The results of this testing program are summarized in Table I. This table shows the means, the standard deviations, and ranges of test scores for the total group, for boys and girls, urban and rural, and for social status groups AB, C, D, and E. Because of the small number, individuals in social class groups A and B were placed in one group for purposes of comparison with the other social class groups.

Results on the Stanford-Binet and Wechsler-Bellevue are given in IQ'S. The Minnesota Paper Form Board results are given in raw scores. Scores on the Iowa Silent Reading and the two Assembly Tests have been converted into T-scores.

T-scores have been used for the Assembly Tests since there are no norms for these tests as we used them.

T-scores were obtained from Median Standard Scores on the Iowa Silent Reading Test.

Ten of the individuals who were out of school when tested had not completed eighth-grade work. The Elementary Form AM (Grades IV–IX) of the Iowa Silent Reading Test was administered to these individuals. Since tables of grade equivalents and median standard scores were available for both the Advanced and the Elementary Forms of the test, it was possible to place these individuals in rank order at the lower end of the distri-

* Items from the Minnesota Mechanical Assembly Test (Nos. 2, 3, 4, 5) were timed. The remainder of the test was given without time limits. Average duration of the test was eighty minutes.

TABLE I.—TEST RESULTS FOR THE SIXTEEN-YEAR-OLD GROUP

	Stanford-Binet				Wechsler-Bellevue				Iowa Silent Reading			
	Mean IQ	SD	N	Range	Mean IQ	SD	N	Range	Mean T-score	SD	N	Range
Total Group....	108	15.8	110	62–143	106	11.8	114	60–128	50.0	10.00	112	25.6–72.4
Boys.....	110	15.2	47	69–141	105	11.2	47	81–125	49.3	10.50	44	27.9–72.4
Girls.....	107	16.2	63	62–143	107	14.8	67	60–128	50.4	7.92	68	25.6–70.1
Urban.....	109	15.9	81	68–143	107	11.6	84	69–128	50.4	11.99	84	27.9–72.4
Rural.....	105	15.5	29	62–128	103	15.2	30	60–126	48.6	10.51	28	25.6–70.1
Status Groups												
AB.....	128	11.2	9	110–143	118	8.8	9	102–126	58.0	6.05	8	54.4–66.9
C.....	112	11.6	42	77–137	109	10.4	44	81–126	51.0	8.08	43	32.6–72.4
D.....	104	15.7	48	68–137	102	12.4	48	66–128	48.9	9.84	48	25.6–70.1
E.....	98	17.2	11	62–122	103	17.2	13	60–122	45.6	13.94	13	25.6–64.6

TABLE I.—(*Continued*)

	Minnesota Paper Form Board				Minnesota Assembly				Chicago Assembly			
	Mean Raw Score	SD	N	Range	Mean T-score	SD	N	Range	Mean T-score	SD	N	Range
Total Group.	35	13.6	115	−4–60	50.0	10.00	46	19.0–67.9	50.00	10.00	66	26.8–67.8
Boys.....	35	12.4	47	3–54								
Girls.....	36	14.4	68	−4–60								
Urban.....	36	13.6	85	−4–60	49.9	10.68	33	19.0–67.9	50.7	9.67	49	29.7–67.8
Rural.....	33	13.4	30	−2–50	50.1	9.28	13	35.8–64.4	47.9	10.39	17	26.8–65.8
Status Groups												
AB.....	44	7.4	9	27–52	46.8	17.32	6	19.0–61.6	62.1	3.15	3	60.1–65.8
C.....	40	10.2	44	14–60	51.6	8.86	17	35.8–67.9	52.0	7.92	25	39.0–67.1
D.....	31	14.6	49	−4–56	48.8	10.05	19	21.1–65.1	48.5	10.25	29	47.8–67.8
E.....	31	15.4	13	−2–48	53.0	10.93	4	47.7–59.6	45.3	9.26	9	26.8–56.2

bution and to assign them scores on the Advanced Form by extrapolation.

Table II gives the coefficients of correlation between tests. Correlations between intelligence tests and between intelligence tests and the Iowa Silent arc light. A very low positive correlation was found between the Binet and the Minnesota Mechanical Assembly Test. A slightly higher correlation is found between the Performance Test and the Mechanical Assembly Test.

TABLE II.—COEFFICIENTS OF CORRELATION BETWEEN TESTS

	Binet	Wechsler	Iowa	Form Board
Wechsler-Bellevue	.66 ± .03			
Iowa Silent	.78 ± .02	.53 ± .04		
Paper Form Board	.51 ± .04	.73 ± .02	.40 ± .05	
Minnesota Assembly	.13 ± .09	.35 ± .08	−.01 ± .1	.28 ± .09
Chicago Assembly	.75 ± .04	.69 ± .04	.51 ± .06	.53 ± .06

Table III gives the critical ratios of the differences between groups. All ratios were calculated, but only those which were greater than 1 have been included in the table. Significant differences between the upper groups (AB and C) and the lower groups (D and E), are found for all tests except the Iowa Silent and the Minnesota Assembly. No significant differences were found between sexes, or between urban and rural groups.

TABLE III.—CRITICAL RATIOS OF THE DIFFERENCES BETWEEN GROUPS

Groups Compared	Binet	Wechsler	Iowa	Form Board	Minn. Assemb.	Chicago Assembly
Boys and Girls						
Urban and Rural	1.2	1.3		1.0		
Status Groups						
AB and C	3.3	2.3	2.3	1.2		3.2
AB and D	4.7	4.0	2.6	3.3		3.9
AB and E	4.1	2.4	2.5	2.3		3.7
C and D	2.7	2.9	1.0	3.9	1.5	1.3
C and E	2.3	1.1	1.2	1.8		1.8
D and E	1.0					

Before discussing the results as given in Table I it is necessary to consider the question whether the means for the various groups have been seriously affected by the absence of test data

on twenty-seven individuals. Conceivably, these persons, all but one of whom had dropped out of school, might have been very low in the abilities tested, thus making the group means higher than they would have been if everybody had been included. Fortunately, there were IQ's from the Otis Intelligence Test in the school records of seventeen of these boys and girls, thus making it possible to compare them in intellectual ability with those who were tested in this study.

The status distribution of those who were not tested was as follows: one in social class B, two in class C, seventeen in class D, six in class E, and one whose status was not known. Those in classes B and C can safely be ignored. They were individuals of average abilities as evidenced by their school records. Their omission from Table I cannot appreciably affect the means for status groups B and C on intelligence tests. This leaves the effect of omissions on the means of groups D and E to be considered further.

The Otis Intelligence Test (1919) had been administered each year to the seventh grade of the public school and to new students in Midwest high school. Individual scores were recorded as IQ's which had been computed in accordance with the 'deviation method' described in the *Manual of Directions* for the Otis Classification Test (1919). Table IV gives the Otis IQ's for those of groups D and E who were tested and for those who were not tested in this study.

TABLE IV.—OTIS IQ'S FOR PERSONS WHO WERE TESTED AND NOT TESTED IN THIS STUDY

Status	Group	In School and Tested		Not in School and Tested		Not in School and Not Tested	
		Mean Otis IQ	N	Mean Otis IQ	N	Mean Otis IQ	N
D		109	27	104	2	105	11
E		106	8	99	2	106	3

Inspection of Table IV indicates that those of class D who were not tested averaged four points lower on the Otis Test than

those who were tested, while those of class E who were not tested averaged nearly the same as those who were tested. The conclusion seems justified that on measures of intellectual ability the members of the E group who were included in our study are representative of the total E group, while the members of the D group who were included in the study may average slightly higher (probably not more than two IQ points) than the total D group. This conclusion is based on the assumption that the six D persons and three E persons for whom there were no data at all, not even an Otis IQ, would not have changed the group means appreciably. These nine boys and girls had never entered high school. They had attended a parochial school or a rural school and had dropped out at the time of graduation from the eighth grade. It seems probable that they would have been inferior in ability to those who stayed in school, and thus their inclusion in the study might have lowered the group means for classes D and E slightly in the tests of intellectual ability.

In summary, the means for groups AB and C have not been affected by the incompleteness of the testing; the means reported for groups D and E on tests of intellectual ability may be slightly higher than they would be if all the members of these groups had been tested, but the relative positions of the two groups is certainly correctly presented.

DISCUSSION OF RESULTS

The principal conclusion of this study is that intellectual ability is closely correlated with social status among sixteen-year-olds, but mechanical ability is not correlated with social status among boys at this age. The differences between the two upper groups (AB and C) and the two lower groups (D and E) are especially large and consistent on all tests of intellectual ability and achievement, but these differences disappear on the Mechanical Assembly Test for boys.

When compared with the data from the tests administered to ten-year-old children in Midwest certain interesting differences become apparent. At the ten-year-old level the children in the higher social groups were superior on all tests to the children of lower status groups. At the sixteen-year-old level, however, the boys of higher social groups had lost their superiority on the Mechanical Assembly Test.

A comparison of correlation coefficients between pairs of tests at the sixteen-year level with analogous coefficients at the ten-year-level gives further support to the inference that the intellectual and the mechanical abilities, which are positively related in younger children, lose much of this relation by the time of later adolescence. The correlation coefficient of Binet IQ and Mechanical Assembly Test score is .66 for ten-year-old boys, and .13 for sixteen-year-old boys. On the other hand, and, as would be expected, the correlation coefficient of Binet IQ with Iowa Silent Reading Test scores increases between the ages of ten and sixteen. Further, in line with the general trend, the correlation coefficient of Binet IQ with Performance Test IQ decreases with increase in age.

The general conclusion is that continued exposure to the differential environments of different social class groups selects out and favors certain abilities, and at the same time discourages or neglects other abilities. Consequently, abilities are more highly differentiated in sixteen-year-olds than in ten-year-olds.

Probably the amount of experience of upper and middle-class boys increases relative to that of lower-class boys with books and other verbal materials as they grow older. On the other hand, the lower-class boys probably spend relatively more times at work or at play with tools and other mechanical devices. Still, this hypothesis needs explicit verification, for it is well known that many middle- and upper-class boys take an active interest in machines and in mechanical hobbies such as photography and model airplane making, and these boys often have access to very well-equipped work-shops.

A more careful analysis of the changes with age in test performance will be made in a later paper.

Other conclusions are: The urban group is slightly but consistently superior to the rural group; and there are no reliable sex differences. Furthermore, as was the case with the ten-year-old group, the Chicago Assembly Test for girls does not test an ability which is clearly separable from the intellectual abilities tested by the intelligence tests. Finally, the average IQ's for the sixteen-year-olds of Midwest are somewhat higher than the national average, as was found to be the case for the ten-year-olds in Midwest.

SUMMARY AND CONCLUSIONS

The following tests were given to all available sixteen-year-old boys and girls residing in a typical middle-western community, both urban and rural; Stanford-Binet, Wechsler-Bellevue (Performance Scale), Iowa Silent Reading, Minnesota Paper Form Board, Minnesota Mechanical Assembly (Modified), Chicago Assembly Test for Girls. The test results were compared for social class groups, urban-rural, and sex groups. Product-moment correlations were calculated for the various pairs of tests.

The results of this study may be summarized as follows:

1) The mean Binet IQ was about 108, which is higher than the national average.

2) Boys and girls from families of higher social status tended to do better in all the tests than boys and girls of lower social position, with the exception of the Mechanical Assembly Test, where there was no reliable social class difference among the boys.

3) Urban boys and girls tended to do better than rural boys and girls, but not significantly so.

4) No significant sex differences were obtained.

5) The results tend to support the view that greater specialization of abilities occurs in adolescents than in younger children, and that such differentiation may be due, in part, to differences in the cultures of the different social class groups which make up the typical American community.

A COMMENT ON THE CORRECTION OF RELIABILITY COEFFICIENTS FOR RESTRICTION OF RANGE

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In a recent issue of this Journal, F. B. Davis† recommends an adaptation of a formula by Pearson which corrects reliability coefficients for restriction of range when the restriction takes place on a correlated variable. The purpose of the present note is to suggest a variant of the correction formula that may suit some circumstances more conveniently. Davis presents his formula (A) as

$$R_{46} = \frac{r_{46} + r_{14}^2\left(\frac{\Sigma_1^2}{\sigma_1^2} - 1\right)}{1 + r_{14}^2\left(\frac{\Sigma_1^2}{\sigma_1^2} - 1\right)}, \tag{1}$$

where

r_{46} = correlation between equivalent halves of the test in the restricted range,

R_{46} = correlation between equivalent halves of the test in the unrestricted range,

r_{14} = correlation between one of the equivalent halves and the variable on which restriction takes place,

σ_1 = standard deviation of the variable of restriction in the restricted range, and

Σ_1 = standard deviation of the variable of restriction in the unrestricted range.

Throughout this note, small letters will refer to values in the restricted range and capital letters to values in the unrestricted range. In addition, the symbol, k, will be used in place of $\left(\frac{\Sigma_1^2}{\sigma_1^2} - 1\right)$.

Since r_{14} is frequently not available in a practical situation, Davis suggests estimating it from the following formula:

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* On military leave.

† F. B. Davis, "A Note on Correcting Reliability Coefficients for Range," *J. Educ. Psychol.*, XXXV (November, 1944), pp. 500–502.

$$r_{14} = \frac{r_{12}\sqrt{2(1 + r_{46})}}{2}, \tag{2}$$

where r_{12} is the correlation between the test whose reliability we are estimating and the variable of restriction. After obtaining this value and calculating R_{46} from formula (1) we must estimate the reliability of the test in the unrestricted range by use of the Spearman-Brown prophecy formula,

$$R_{2II} = \frac{2R_{46}}{1 + R_{46}}. \tag{3}$$

Let us trace the development of the variant of Davis' formula (*A*). In the restricted range, (3) may be written as

$$r_{2II} = \frac{2r_{46}}{1 + r_{46}}. \tag{4}$$

Square both sides of (2) and obtain

$$r_{14}^2 = \frac{r_{12}^2(1 + r_{46})}{2}. \tag{5}$$

Substitute (1) into (3). This results in

$$R_{2II} = \frac{2r_{46} + 2r_{14}^2k}{1 + r_{46} + 2r_{14}^2k}. \tag{6}$$

Divide both numerator and denominator of (6) by $(1 + r_{46})$ and write it as

$$R_{2II} = \frac{\dfrac{2r_{46}}{1 + r_{46}} + \dfrac{2r_{14}^2k}{1 + r_{46}}}{1 + \dfrac{2r_{14}^2k}{1 + r_{46}}}. \tag{7}$$

Substitution of (4) and (5) into (7) leads to

$$R_{2II} = \frac{r_{2II} + r_{12}^2k}{1 + r_{12}^2k}, \tag{8}$$

which is the suggested variant.

The latter may also be derived from the Kelley formula,*

$$R_{2II} = 1 - \frac{\sigma_2^2}{\Sigma_2^2}(1 - r_{2II}), \tag{9}$$

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* T. L. Kelley, *Statistical Method*, New York: Macmillan Co., 1924, p. 222.

by taking advantage of an estimate of Σ_2 presented by Brogden as formula (11) in a recent article:*

$$\Sigma_2 = \sigma_2 \sqrt{1 + r_{12}^2 k}. \tag{10}$$

On combining (9) and (10) we shall again end up with (8).

A third approach to formula (8) starts with Pearson's original formula:

$$R_{23} = \frac{r_{23} + r_{12} r_{13} k}{\sqrt{[1 + r_{12}^2 k][1 + r_{13}^2 k]}}. \tag{11}$$

Here we merely assume that we have two comparable forms of the same test. The correlation of these forms, r_{23}, gives us the reliability in the restricted range, r_{2II}, and the correlation of the one form we actually have with the variable of restriction, r_{12}, is assumed equal to that of the hypothetical, comparable form with the same variable, r_{13}. Formula (11) immediately reduces to (8).

Each of the formulas, (1), (8), and (11), finds its principal value and/or convenience in a specific set of conditions. These sets of conditions are listed below by way of summary. It is assumed that the value of k is known.

1) Given r_{46} and r_{12}. Use (4) and then (8). If (1) were to be used, it would be necessary to compute (2), (1) and then (3).

2) Given r_{2II} and r_{12}. Use (8) here directly. Evaluation of three subsidiary formulas would be necessary with (1).

3) Given r_{46} and r_{14}. Use (1) and then (3). Evaluation of two subsidiary formulas would be necessary with (8).

4) Given r_{2II}, r_{12} and r_{43}. Use (11) here directly.

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* H. E. Brogden, "On the Estimation of the Changes in Correlation and Regression Constants Due to Selection on a Single Given Variable," *J. Educ. Psychol.*, XXXV (November, 1944), pp. 484–492.